

## WHAT IS CLAIMED IS:

1. An isolated polynucleotide containing a nucleic acid sequence encoding a modified plant phytoene desaturase enzyme having increased resistance to one or more bleaching herbicides, the modified plant phytoene desaturase enzyme having at least one amino acid substitution that provides said increased resistance.
2. An isolated polynucleotide according to claim 1, wherein said polynucleotide is selected from:
  - (a) a polynucleotide encoding a plant phytoene desaturase enzyme having an amino acid sequence at least 80% identical to amino acids 109 to 580 of SEQ ID NO: 2, said amino acid sequence having a point mutation corresponding to one or more of positions 304, 425, 509, and 542 of SEQ ID NO: 2;
  - (b) a polynucleotide encoding a plant phytoene desaturase enzyme having an amino acid sequence at least 80% identical to amino acids 97 to 570 of SEQ ID NO: 4, said amino acid sequence having a point mutation corresponding to one or more of positions 294, 415, 499, and 532 of SEQ ID NO: 4;
  - (c) a polynucleotide having encoding a plant phytoene desaturase enzyme having an amino acid sequence at least 80% identical to amino acids 97 to 571 of SEQ ID NO: 6, said amino acid sequence having a point mutation corresponding to one or more of positions 292, 413, 497 and 530 of SEQ ID NO: 6; and

(d) a polynucleotide having encoding a plant phytoene desaturase enzyme having an amino acid sequence at least 80% identical to amino acids 93 to 566 of SEQ ID NO: 8, said amino acid sequence having a point mutation corresponding to one or more of positions 288, 409, 493, and 526 of SEQ ID NO: 8.

3. An isolated polynucleotide according to claim 2, which is a polynucleotide encoding a plant phytoene desaturase enzyme having an amino acid sequence at least 80% identical to amino acids 109 to 580 of SEQ ID NO: 2, said amino acid sequence having a point mutation corresponding to one or more of positions 304, 425, 509, and 542 of SEQ ID NO: 2.

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4. An isolated polynucleotide according to claim 3, which encodes a plant phytoene desaturase enzyme that is at least 95% identical to amino acids 109 to 580 of SEQ ID NO: 2.

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5. An isolated polynucleotide according to claim 4, which encodes the amino acid sequence from amino acid 109 to 580 of SEQ ID NO: 2, except having a point mutation corresponding to one or more of positions 304, 425, 509, and 542.

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6. An isolated polynucleotide according to claim 2, which is a polynucleotide encoding a plant phytoene desaturase enzyme having an amino acid sequence at least 80% identical to amino acids 97 to 570 of SEQ ID NO: 4, said amino acid sequence having a point mutation

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corresponding to one or more of positions 294, 415, 499, and 532 of SEQ ID NO: 4.

7. An isolated polynucleotide according to claim  
5 6, which encodes an amino acid sequence that is at least 95% identical to amino acids 97 to 570 of SEQ ID NO: 4.

8. An isolated polynucleotide according to claim  
10 7, encodes the amino acid sequence from amino acid 97 to 570 of SEQ ID NO: 4, except having a point mutation corresponding to one or more of positions 294, 415, 499, and 532 of SEQ ID NO: 4.

15 9. An isolated polynucleotide according to claim 2, which is a polynucleotide encoding a plant phytoene desaturase enzyme having an amino acid sequence at least 80% identical to amino acids 97 to 571 of SEQ ID NO: 6, said amino acid sequence having a point mutation  
20 corresponding to one or more of positions 292, 413, 497 and 530 of SEQ ID NO: 6.

10. An isolated polynucleotide according to claim 9, which encodes an amino acid sequence that is at  
25 least 95% identical to amino acids 97 to 571 of SEQ ID NO: 6.

11. An isolated polynucleotide according to claim 7, which encodes the amino acid sequence from amino  
30 acid 97 to 571 of SEQ ID NO: 6, said amino acid sequence having a point mutation corresponding to one

or more of positions 292, 413, 497 and 530 of SEQ ID NO: 6.

12. An isolated polynucleotide according to claim  
5 2, which is a polynucleotide encoding a plant phytoene  
desaturase enzyme having an amino acid sequence at  
least 80% identical to amino acids 93 to 566 of SEQ ID  
NO: 8, said amino acid sequence having a point mutation  
corresponding to one or more of positions 288, 409,  
10 493, and 526 of SEQ ID NO: 8.

13. An isolated polynucleotide according to claim  
12, which encodes an amino acid sequence that is at  
least 95% identical to amino acids 93 to 566 of SEQ ID  
15 NO: 8.

14. An isolated polynucleotide according to claim  
13, which encodes the amino acid sequence from amino  
acids 93 to 566 of SEQ ID NO: 8, said amino acid  
20 sequence having a point mutation corresponding to one  
or more of positions 288, 409, 493, and 526 of SEQ ID  
NO: 8.

15. A nucleic acid construct comprising a  
25 polynucleotide of any of claims 1-14.

16. A nucleic acid construct according to claim  
15, wherein said polynucleotide is operably associated  
with a promoter.

17. A nucleic acid construct according to claim 16, which is an expression vector.

18. An isolated, modified plant phytoene  
5 desaturase enzyme having increased resistance to one or more bleaching herbicides, the modified plant phytoene desaturase enzyme having at least one amino acid substitution that provides said increased resistance.

10 19. An isolated, herbicide-resistant plant phytoene desaturase enzyme according to claim 18, wherein said enzyme has an amino acid sequence at least about 80% identical to any one of SEQ ID NOs. 2, 4, 6, and 8.

15 20. An herbicide-resistant crop plant including in its genome a polynucleotide containing a nucleic acid sequence encoding a modified plant phytoene desaturase enzyme having increased resistance to one or  
20 more bleaching herbicides, the modified plant phytoene desaturase enzyme having at least one amino acid substitution that provides said increased resistance.

21. The herbicide-resistant crop plant of claim  
25 20, wherein said plant is a transgenic plant.

22. The herbicide-resistant crop plant of claim 20, wherein said plant is a non-transgenic plant.

23. The herbicide-resistant crop plant of any of claims 20-22, wherein said crop plant is maize, soybean, or rice.

5        24. The herbicide-resistant crop plant of claim 23, wherein the crop plant is maize.

25. The herbicide-resistant crop plant of claim 24, wherein the maize plant includes a polynucleotide  
10 encoding a modified maize phytoene desaturase enzyme.

26. The herbicide-resistant crop plant of claim 25, wherein the modified maize phytoene desaturase enzyme has an amino acid substitution corresponding to  
15 one or more of positions 292, 413, 497 and 530 of SEQ ID NO: 6.

27. The herbicide-resistant crop plant of claim 23, wherein the crop plant is rice.  
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28. The herbicide-resistant crop plant of claim 27, wherein the rice plant includes a polynucleotide encoding a modified rice phytoene desaturase enzyme.

25        29. The herbicide-resistant crop plant of claim 28, wherein the modified rice phytoene desaturase enzyme has an amino acid substitution corresponding to one or more of positions 288, 409, 493, and 526 of SEQ  
ID NO: 8.

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30. The herbicide-resistant crop plant of claim 23, wherein the crop plant is soybean.

31. The herbicide-resistant crop plant of claim 5 30, wherein the soybean plant includes a polynucleotide encoding a modified soybean phytoene desaturase enzyme.

32. The herbicide-resistant crop plant of claim 10 25, wherein the modified soybean phytoene desaturase enzyme has an amino acid substitution corresponding to one or more of positions 294, 415, 499, and 532 of SEQ ID NO: 4.

33. A method for making an herbicide-resistant 15 crop plant, comprising:

modifying a crop plant to incorporate in its genome a polynucleotide containing a nucleic acid sequence encoding a modified plant phytoene desaturase enzyme having increased resistance to one or more 20 bleaching herbicides, the modified plant phytoene desaturase enzyme having at least one amino acid substitution that provides said increased resistance.

34. A method according to claim 33, wherein said 25 modifying comprises introducing said polynucleotide so as to form a transgenic, herbicide-resistant crop plant.

35. A method according to claim 33, wherein said 30 modifying comprises modifying a native phytoene

desaturase gene of the crop plant so as to form a non-transgenic, herbicide-resistant crop plant.

36. A method for controlling the growth of  
5 undesired vegetation growing at a location where a  
plant has been cultivated, said plant having an  
expressible nucleotide sequence encoding a plant  
phytoene desaturase protein having at least one point  
mutation relative to the wild-type nucleotide sequence  
10 encoding plant phytoene desaturase protein such that  
said plant is rendered resistant to a bleaching  
herbicide; said method comprising applying to the  
location an effective amount of said bleaching  
herbicide.

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37. The method of claim 36, wherein said  
expressible nucleotide sequence is selected from:

(a) a polynucleotide encoding a plant phytoene  
desaturase enzyme having an amino acid sequence at  
20 least 80% identical to amino acids 109 to 580 of SEQ ID  
NO: 2, said amino acid sequence having a point mutation  
corresponding to one or more of positions 304, 425,  
509, and 542 of SEQ ID NO: 2;

(b) a polynucleotide encoding a plant phytoene  
25 desaturase enzyme having an amino acid sequence at  
least 80% identical to amino acids 97 to 570 of SEQ ID  
NO: 4, said amino acid sequence having a point mutation  
corresponding to one or more of positions 294, 415,  
499, and 532 of SEQ ID NO: 4;

30 (c) a polynucleotide having encoding a plant  
phytoene desaturase enzyme having an amino acid



sequence at least 80% identical to amino acids 97 to 571 of SEQ ID NO: 6, said amino acid sequence having a point mutation corresponding to one or more of positions 292, 413, 497 and 530 of SEQ ID NO: 6; and

5 (d) a polynucleotide having encoding a plant phytoene desaturase enzyme having an amino acid sequence at least 80% identical to amino acids 93 to 566 of SEQ ID NO: 8, said amino acid sequence having a point mutation corresponding to one or more of  
10 positions 288, 409, 493, and 526 of SEQ ID NO: 8.

38. The method of claim 37, wherein said plant is maize, soybean, or rice.

15 39. The method of claim 38, wherein said plant is maize.

40. The method of claim 39, wherein said expressible nucleotide sequence includes a  
20 polynucleotide having encoding a plant phytoene desaturase enzyme having an amino acid sequence at least 80% identical to amino acids 97 to 571 of SEQ ID NO: 6, said amino acid sequence having a point mutation corresponding to one or more of positions 292, 413, 497  
25 and 530 of SEQ ID NO: 6.

41. The method of claim 38, wherein said plant is rice.

30 42. The method of claim 41, wherein said expressible nucleotide sequence includes a

polynucleotide having encoding a plant phytoene desaturase enzyme having an amino acid sequence at least 80% identical to amino acids 93 to 566 of SEQ ID NO: 8, said amino acid sequence having a point mutation  
5 corresponding to one or more of positions 288, 409, 493, and 526 of SEQ ID NO: 8.

43. The method of claim 38, wherein said plant is soybean.  
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44. The method of claim 43, wherein said expressible nucleotide sequence includes a polynucleotide encoding a plant phytoene desaturase enzyme having an amino acid sequence at least 80%  
15 identical to amino acids 97 to 570 of SEQ ID NO: 4, said amino acid sequence having a point mutation corresponding to one or more of positions 294, 415, 499, and 532 of SEQ ID NO: 4.

20 45. A method for selecting for a bleaching herbicide resistant cell, tissue or plant, comprising providing within the cell, tissue or plant an expressible nucleotide sequence encoding a plant phytoene desaturase protein having at least one point  
25 mutation relative to the wild-type nucleotide sequence encoding plant phytoene desaturase protein, such that said plant is rendered resistant to a bleaching herbicide; and

applying to the cell, tissue or plant an effective  
30 amount of said bleaching herbicide.

46. A method according to claim 45, wherein said expressible nucleotide sequence is coupled to a second nucleotide sequence for providing a desired trait to be introduced into the cell, tissue or plant.

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47. A method according to claim 46, wherein said providing includes introducing into the cell, tissue or plant a transformation vector containing the expressible nucleotide sequence and second nucleotide  
10 sequence.

48. A method according to any of claims 45-47, wherein said expressible nucleotide sequence is selected from:

15 (a) a polynucleotide encoding a plant phytoene desaturase enzyme having an amino acid sequence at least 80% identical to amino acids 109 to 580 of SEQ ID NO: 2, said amino acid sequence having a point mutation corresponding to one or more of positions 304, 425,  
20 509, and 542 of SEQ ID NO: 2;

(b) a polynucleotide encoding a plant phytoene desaturase enzyme having an amino acid sequence at least 80% identical to amino acids 97 to 570 of SEQ ID NO: 4, said amino acid sequence having a point mutation  
25 corresponding to one or more of positions 294, 415, 499, and 532 of SEQ ID NO: 4;

(c) a polynucleotide having encoding a plant phytoene desaturase enzyme having an amino acid sequence at least 80% identical to amino acids 97 to  
30 571 of SEQ ID NO: 6, said amino acid sequence having a

point mutation corresponding to one or more of positions 292, 413, 497 and 530 of SEQ ID NO: 6; and

(d) a polynucleotide having encoding a plant phytoene desaturase enzyme having an amino acid sequence at least 80% identical to amino acids 93 to 566 of SEQ ID NO: 8, said amino acid sequence having a point mutation corresponding to one or more of positions 288, 409, 493, and 526 of SEQ ID NO: 8.49. A method according to claim 48, wherein the cell, tissue or plant is a maize cell, maize tissue, or maize plant.

50. A method according to claim 48, wherein the cell, tissue or plant is a rice cell, rice tissue, or rice plant.

51. A method according to claim 48, wherein the cell, tissue or plant is a soybean cell, soybean tissue, or soybean plant.